EXPLORING INNER SOURCE AS A FORM OF INTRA-ORGANISATIONAL OPEN INNOVATION

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Abstract

Open Innovation, of which open source software (OSS) is a well-cited example, can be analysed at a number of levels, including the inter- and intra-organisational networking level. However, most research to date on open innovation has focussed on inter-firm level and inter-organisational networking, hence neglecting the implications that open innovation has 'within' the organisation. Inner source leverages key open source practices in order to decouple platform and products groups with respect to their release timing. Similar to open source development, inner source applies an open, concurrent model of collaboration and thus could be seen as a good exemplar of open innovation at the intra-organisational level. However there is a paucity of research exploring inner source as a form of open innovation within organisations. Additionally, there is limited research that has examined the influence of inner source development on the creation and management of internal networks. Using a case study approach, we seek to address this gap. The findings are analysed using a theoretical framework of three core open innovation processes as a lens to examine inner source as a form of open innovation inside a company.

Keywords: Open Source Software, Inner Source, Open Innovation, Intra-organisational networking

1   Introduction

The open innovation concept challenges the dominant view of closed innovation, which assumes that it is the experts 'within' the company that invent and design innovative new products to meet customer needs (Chesbrough, 2006). Open innovation can be analysed at a number of levels, which include the inter-organisational and intra-organisational networking level. In terms of inter-organisational networking, such collaboration has been referred to as a value network (Christensen and Rosenbloom, 1995; Morgan et al., 2010) or an ecosystem (Adner, 2006; Iansiti and Levien, 2004a). While most research focuses on inter-organisational aspects, open innovation also increases the significance of intra-organisational networks insofar as the effective management of externally acquired knowledge often requires the development of complementary internal networks (cf. West et al., 2006; Hansen and Nohria, 2004). While becoming more open to the outside may bring considerable benefits to many firms, these can only be harnessed through an adaptation of how processes are organised inside the firm (Alexy and Henkel 2009). The implications, however, that open innovation has within an organisation and in particular the fact that it affects different parts of an organisation differently are largely neglected in the current literature (Alexy and Henkel 2009). While there exists much research about intra-organisational level networking in general to stimulate innovation (e.g., Tsai and Ghoshal 1998; Foss and Pedersen 2002; Lagerstrom and Andersson 2003), this type of networking has not been analysed explicitly within the open innovation context (Vanhaverbeke 2006).

A popular example of open innovation is open source software (OSS). Applying open source software development practices inside a closed environment of a company, something also termed inner source, is now an attractive approach for many larger organisations (Wesselius, 2008). Indeed research to date has shown that the key principles of inner source are a good way to overcome many of the issues associated with traditional platform development (Wesselius, 2008, Lindman et al., 2008). With traditional platform development, companies develop different variations of essentially the same product in order to decrease the amount of redundant work through software reuse. This enables companies to reduce the amount of time to market as well as costs, while making their products more robust. One significant problem however with traditional platform development is that a platform can become a bottleneck in the company, especially when multiple product teams are using the same platform (Oor and Krikhaar, 2008). To overcome these difficulties, companies deploy and leverage key open source practices 'within' the corporate environment (Melian and Mähring, 2008; Fitzgerald, 2006; Oor and Krikhaar, 2008).

Comparable to open source development, inner source applies an open, concurrent model of collaboration and hence could be seen as a good exemplar of intra-organisational open innovation. Inner source development involves distributed ownership and control of code, early and frequent releasing, and many continuous feedback channels (Van der Linden, 2009). However, there is a paucity of research exploring inner source as a form of open innovation within an organisation. This is surprising considering that there are many good reasons why firms move from closed software development to inner source development, e.g in terms of gaining efficiency, reducing time to market, optimal sharing of human assets in the company etc. (Wesselius, 2008). Inner source development also features a high degree of openness that allows us to discern patterns of open innovation within the company. In addition, it portrays a good example of firms opening up the boundaries of their relevant business units to engage in collaborative efforts with other stakeholders and thus provides fertile ground on which to study the intra-organisational implications of opening up innovation processes within a company. There is also limited research that has examined the influence of inner source development on the creation and management of internal networks. Thus, we seek to address this gap by (i) placing inner source in the context of the open innovation literature and exploring how it fosters internal networking within an organisation, and (2) highlighting some of the challenges associated with establishing and maintaining these networks. To achieve this, we use a theoretical framework described in section 2 as a lens to examine inner source as a form of open innovation within the

organisation. This is followed by a discussion of the research methodology (section 3) and our case study findings (section 4). Our discussion and conclusions (section 5) reveal that open innovation practices are in operation in the company, revealing the need to increase innovativeness and knowledge-sharing by opening up internal software innovation processes. However, achieving open innovation within the organisation can be extremely challenging. For example, establishing and maintaining successful cooperative relations in networks require a high level commitment from stakeholders, knowledge sharing and exchange, a common vision and the effective combination and governance of resources and capabilities in the network.

2 Theoretical Framework

For our theoretical base, we propose a framework drawn from three central open innovation archetypes (see Figure 1) proposed by Gassmann and Enkel (2004). This framework has been utilised and validated in studies carried out by Conboy and Morgan (2011) on combining open innovation and agile methods, Feller et al. (2010) on opening the boundaries of public administrations and Grøtnes (2009) on open innovation in the mobile industry. We feel the framework also provides a useful lens to examine open innovation at the intra-organisational level. The archetypes include: (1) the outside-in process whereby a company's innovativeness can increase through the integration of suppliers, customers and external knowledge sourcing; (2) the inside-out process where companies can earn profits by bringing ideas to market and transferring ideas to the outside environment; and (3) the coupled process where companies combine the outside-in and inside-out processes by working in alliance with complimentary partners where give and take is vital for success.

2.1 The Outside-in Process

Companies that typically decide on an outside-in process as a core open innovation approach choose to cooperate with suppliers, customers third parties etc. and integrate the external knowledge gained (Gassmann and Enkel, 2004). This can be achieved by investing in global knowledge creation, applying innovation across industries, customer and supplier integration and purchasing intellectual property. It has also been suggested that if firms possess the necessary competencies and capabilities, they can successfully integrate internal company resources with the critical resources of other members such as customers, suppliers etc, by extending new product development across organisational boundaries (Gassmann and Enkel, 2004). As the focus of this research in on intra-organisational open innovation, an outside-in open innovation approach will refer to the integration of external knowledge and resources gained from multiple stakeholders outside a business unit.

2.2 The Inside-Out Process

The inside-out process focuses on the externalising of company knowledge and innovation in order to bring ideas to market faster. This approach includes licensing IP or multiplying technology by transferring ideas to other companies. In addition, outsourcing can be used to channel knowledge and ideas to the external environment (Gassmann and Enkel, 2004). In the context of this study, an inside-out process refers to leveraging and transferring knowledge to stakeholders outside the boundaries of a business unit and gaining certain advantages by letting ideas flow to the outside.
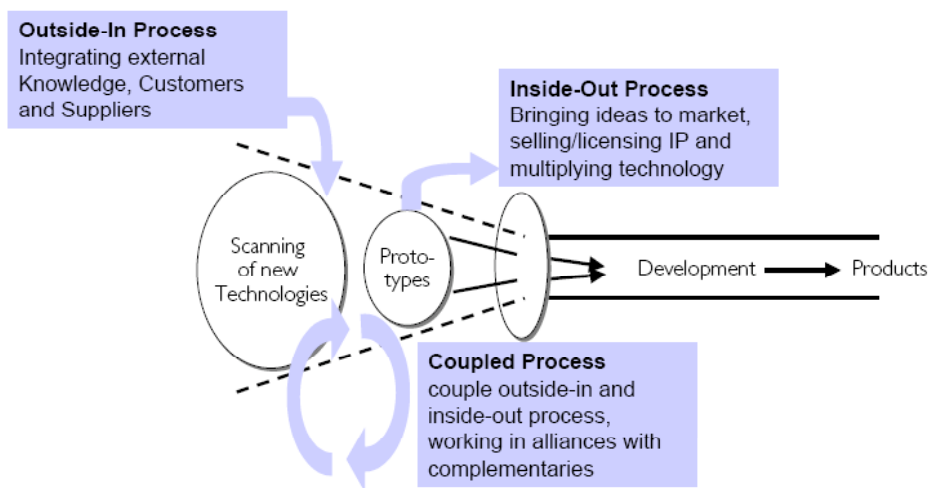
Figure 1: Three Open Innovation Archetypes (Source: Gassmann and Enkel, 2004)

2.3   The Coupled Process

The coupled process combines the outside-in (gaining external knowledge) with the inside-out process (bringing ideas to market).   In order to accomplish both, organisations collaborate and cooperate with other companies (e.g. strategic alliances, joint ventures), suppliers and customers, as well as universities and research institutes.   To collaborate and cooperate successfully, a give and take of knowledge approach is crucial.   Benefits of such an approach include an intensive exchange of knowledge and a mutual learning process.   In this study, a coupled process refers to how business units or product teams cooperate and interact with each other in intra-organisational networks. Networks provide opportune access to knowledge and resources that are otherwise unavailable, while also testing internal expertise and learning capabilities (Powell, 1998). Simard and West (2006) also argue that innovation is positively influenced by a firm's access to complementary skills and a broad knowledge-base that facilitates different types of knowledge exchange in a network context. In addition, substantial knowledge exchange in a network facilitates joint learning, fosters problem-solving, and the integration of complementary resources enables joint creation of products, technologies and services (Parise and Henderson, 2001). However, resources and capabilities of network actors have to be effectively combined and governed at the network level.   Trust, leadership and a unifying vision play an important role in bringing disparate partners together in a network and the absence of internal competition among participants in the network is crucial (Gomes-Casseres, 2003). Thus, the firm will have to actively nurture the value network to manage potential tensions or conflict between participants. Additionally, the firm has to make a number of arrangements with other participants to stick to the network, e.g. offer incentives such as access to information and knowledge, compensation etc. (Vanhaverbeke and Cloodt, 2008).

3   Research Methodology

Given the scarcity of empirical work in the area of intra-organisational open innovation and the need to obtain rich data, the study is considered exploratory in nature and thus, a case study research strategy was considered most appropriate (cf. Yin, 2003).   Case studies can be very valuable in generating an understanding of the reality of a particular situation, and can provide a good basis for discussion.   In addition, there is no attempt at experimental design or control of variables.

The case organisation is a supplier of medial equipment and devices and designs imaging systems, including X-ray, ultrasound and magnetic resonance machines that enable radiologists and cardiologists to study images of the human body.   The company has grown rapidly in recent years, largely through acquisitions.   Today the company employs 30,000 employees and has dual

headquarters in the USA and the Netherlands. This company utilises open source practices in the distributed development of their product line – something termed inner source. Software components were traditionally developed by a central platform development group for a large number of product features and functions. These components were then integrated into the medical equipment by the various product groups. Product teams would send their requirements to the platform group and receive software components after long periods of time. However, the platform development group faced the problem of becoming a bottleneck to the many application development groups. Domain releases were planned in a process with many stakeholders, so the resulting release schedule did not satisfy the planning of certain application engineering groups. Additionally, product groups lacked the flexibility in responding to market changes. The use of inner source principles facilitates internal collaboration and networking in an open manner between platform and product teams in the firm. Each application engineering group can decide themselves whether they wait for the next release of the platform; change components or contribute through patches; and also work together as a virtual team. In the company, inner source has enabled new product launches since 2005 and had reduced time to market by three months.

Table 1: Data Sources

Interviews	International Partnership Project Manager (three interviews)
	Director of Software Services
	Software Team Leader
	Program Manager Interoperability & Security
	Development Manager
	Business Architect

A case study protocol (cf. Yin, 1994) was prepared and data was gathered over a four-week period during 2010. Data gathering techniques included face-to-face interviews with all participants, which were tape-recorded and transcribed. Interviews were complemented by a comprehensive review of publicly available documents, including two deliverables, five reports from three EU funded projects of which the case organisation was a participant, and secondary content such as newspaper articles etc. related to the company. The choice of interviewees was based on (a) their willingness to cooperate and (b) the company's history of engagement with OSS. Face-to-face interviews, conducted using an interview guide (cf. Patton, 1990), were generally of one to two hour duration, with follow-up telephone interviews used to clarify and refine issues that emerged during transcription.

Interview data was transcribed, generating on average 100 pages of field notes. Data analysis was undertaken using coding techniques proposed by Strauss and Corbin (1990). The first step (open coding) involved the data being examined "line by line" to ascertain the main ideas. They were then grouped by meaningful headings to reveal categories and subcategories/properties. For example, the categories included the items from Figure 1, i.e. outside-in, inside-out and coupled while sub-categories included items such as networking, knowledge and information sharing, cooperation, ownership, collaboration etc. The next step (axial coding) was the process of determining relationships between categories and its subcategories. As a list of codes began to emerge, the analysis moved to a higher or more abstract level, looking for a relationship between the codes. Once a relationship was determined, the focus returned to the data to question the validity of these relationships. The final step (selective coding) involved determining a core category; that category that is connected to most of the other categories.

4 Findings

4.1 Inner Source as Open Innovation within the Organisation

As part of their inner source initiative, the case organisation has applied and leveraged various open source techniques and tools in the distributed development of their product line – ideas that were inspired and derived from open source practices and benefits. For example, the key aspects borrowed from open source development by the company are (1) a development model based on open collaboration (one such element that OSS shares with the open innovation concept); (ii) distributed ownership of the source code (another key OSS element that is considered open innovation) and (iii) frequent release of software components and incremental integration. This inner source initiative in the company has overcome many of the issues associated with the company's contemporary platform development. Traditionally, a central software team was responsible for developing components. However, product releases were increasingly dependent on the platform and often release schedules were slow and suffered from misalignment. As research and development in the company is distributed across three continents, i.e., Europe, India and USA, communications also became more complex and cumbersome. Additionally, the central group lacked the domain knowledge and competencies needed to develop shared components. Thus, while the central group still retain responsibility of the platform, the purpose of introducing the inner source initiative in the company was to facilitate the optimal sharing of knowledge and expertise of all product teams, provide easy access to all the information of the product line, improve communication and cooperation among teams, promote reuse of software, and provide groups that initially depended on the content and quality of the platform with an adequate level of ownership and control. Furthermore, all three open innovation archetypes proposed by Gassmann and Enkel are evident in the context of inner source development in the organisation (see Table 2).

4.1.1 The Outside-In Process

In the company, there is a central group or platform team responsible for the common platform development. As part of an outside-in approach, the central group draw on ideas and knowledge for customisations and configurations from various business units outside the boundaries of their own unit. Using an outside-in process has resulted in a much stronger involvement of platform customers, i.e. other product teams etc., improved efficiency and additionally increased organisational learning and knowledge-sharing and exchange as development now crosses department borders. As one interviewee explained "the combined knowledge in that community has resulted in a lot more awareness and as a result we are getting a lot more efficiency in our development" (Software Team Leader). The central group also feel they have increased their innovativeness through the integration of knowledge, ideas and feedback they gain from various business units. The collaborative aspect adds a lot of value because it results in users getting products that work well for them in additional to receiving them earlier that anticipated. Moreover, as there is a continued corporate pressure to reduce costs and time to market, to standardise and harmonise, applying the outside-in process has proved hugely beneficial for the central group. As another respondent pointed out,

> "the biggest value for us is how we collaborate as a platform team with other product teams. And we have learned a lot from open source and that's where we get a lot of value" (Partnership Project Manager).

4.1.2 The Inside-out Process

As regards an inside-out process, the central group make available developed software code to other business units. Additionally, the central group offer services to other business units, e.g. support and

maintenance, platform training to engineers all over the world etc. Teams are also given the flexibility to add things and at a later stage, consolidate it in the platform to ensure that this value is leveraged to other teams as well. As the Software Team Leader of the central group explained;

> "It is all out there. Everybody can take a look at it. We have a Wiki to share knowledge, best practices on how to use the platform, technical details about the platform, those kinds of things. We use support mailing lists to have people help each other so you see product teams helping each other and therefore, the community affect growing"

Thus, where the development model used to be quite black box in the company, today it is completely open across the entire organisation. Another respondent pointed out, "the old model was one where you gave us money and requirements and some of the product would come out. Now everything is out in the open, all our documents, all our software, progress information etc...everybody can take a look at it" (Business Architect). The main inner source development principles are to have easy access to the information and expertise of the entire product line, which in turn improves platform and product quality. While the central team owns and develops components, an application developer can also change components and offer the changes back to the domain team. Consequently, this promotes software reuse as well as distributed ownership and control of the code. The inside-out approach has also brought about more efficiency in development as well as improved collaboration and communications between application and platform teams, resulting in the platform being more widely adopted.

4.1.3 The Coupled Process

A coupled process is also evident in that the central group and product teams work together collaboratively in many co-developed activities and projects. In this way, the central team feel they have learned a great deal from combining knowledge and capabilities. Applying open source practices inside the company has resulted in global development all over the world and the company now have a network society of people spread across three continents that have never met but are still able and willing to collaborate. The inner source initiative in the company has resulted in open collaboration and networking between all teams and as was pointed out, "to survive we have to do this, we need to have this open model" (Partnership Project Manager). Another interviewee pointed out that five years ago, everyone would simply "do their own thing and have no inclination of what the person next door was doing at the same time" (Software Team Leader). This has now changed in the organisation and as this Software Team Leader further explained,

> "the openness of our development model – everybody can see what's going on. There are hundreds of projects and everybody can simply see it. So it's like Source Forge out there, but we have that internally".

Thus, there has been tremendous change for the company as there is a lot more awareness now that everyone can see what is going on and as a result, there is much more transparency, efficiency and cooperation in development. Improved collaboration between the central team and other business units has resulted in greater access to quality and expertise, improved trust and feedback, employee empowerment and consequently more innovation and better solutions and products. The case study findings revealed that products are created earlier using this mode of collaboration and have been picked up eagerly by the markets. Additionally, this internal network continues to grow and grow and shows no signs of diminishing. Sharing resources and capabilities in the form of knowledge, expertise, experience of others etc. was viewed as being extremely beneficial in this network as it also avoids duplicate work. As one interviewee explained "the economic value of simply sharing resources and them making something that makes everybody happy, that's an easy sum to make" (Partnership Project Manager).

Table 2: Description of Open Innovation Archetypes and Benefits within the Company

Archetypes	*Description*	*Benefits*
Outside-in Process	The central team draw on ideas, expertise and knowledge from other business units for software development	• Knowledge sharing and exchange • Reduces time to market • Improves platform use • Improves involvement of product teams • Easy access to all information • Improves feedback by being open • Cost savings • Increases efficiency in development
Inside-Out Process	Developed software and code made available to all business units. Wiki available for sharing and exchange of knowledge, support mailing lists to promote cooperation and assistance among various groups	• Direct communications • Improves platform and product quality • Easy access to all information • Distribute ownership and control • Improves knowledge sharing and exchange • Increases efficiency in development • Promotes software reuse • Improves adoption rate of the platform
Coupled Process	Combination of outside-in and inside-out establishes co-operative network of development teams	• Increases organisational learning • Improves collaboration with groups in Europe, USA, India • Knowledge sharing and exchange • Increases trust in platform • Avoidance of duplicate work • Empowers developers and project leaders • Products created earlier and time to market reduced • Increases innovative capacity and speed

4.2 Challenges Associated with Inner Source Networks

Communicating and cooperating in an internal network and sharing experiences and expertise, while at the same capturing valuable knowledge, skills and ideas was viewed as extremely beneficial and something that was 'fun to do' for many stakeholders in the case organisation. However, establishing and maintaining a cooperative ecosystem or network of teams requires a high level of commitment, high volume of knowledge sharing and exchange among stakeholders, a common vision and successful alignment of objectives and finally an effective governance process (see Table 3). While no research has focused on these characteristics in an inner source context, these findings do compliment those of Simard and West, 2006; Parise and Henderson, 2001; Gomes-Casseres, 2003; and Vanhaversbeke and Cloodt, 2003, who arrived at the same conclusions in their research on interorganisational networks and value constellations in general, (see Section 2.3). For example, it was found in the study that it is often difficult to achieve a high level of commitment from various participants and often there are conflicts of interest that need to be addressed on a continuous basis. As the Software Team Leader of the central group in the company described:

> "a product team wants to be helped at this time only for their problem. They don't care about the platform and of course the platform is only valuable if we can deliver our results to more than one party. Otherwise there's no point in making a platform".

Thus, while some participants continuously contribute to the network, "it is not always something that is in the hearts and minds of everyone in this company" (Partnership Project Manager). Consequently, the motivation needs to be there among all network participants to stay committed to the network because in some cases "it can take a long period of time before you see results" (Developmental

Manager). It was also found that being part of a larger network is something that is very important to people, especially those in the platform team. As one interviewee pointed out "the platform team are very motivated to make sure they make something that will eventually land in many, many products" (Software Team Leader). However, for product teams, it is more difficult to collaborate and network with others because,

> "they are in a much more conflicting situation in a sense that they have the marketers shouting to have features out, and they want them now, and they want more…these people do want to collaborate.. but then at some higher layer, there's this obstruction. So the short term versus the long term result is always the heart of the conflict" (Software Team Leader).

Additionally, it was found that a high volume of knowledge exchange is important in facilitating successful networking as this facilitates value creation, joint learning and fosters problem-solving. However, it is often difficult to get people to invest sufficient time in sharing and exchanging knowledge. One interviewee pointed out that one of the ideas behind the inner source model is,

> "we add value by a platform engineer learning something about the clinical side and a product engineer learning something about the internal platform. What you very often see is that in those teams there is still segregation of that. Platform people are doing platform stuff and the product people are doing product stuff. And there's not a lot of room there to manoeuvre. So you really need engineers that have a lot of drive themselves to look beyond their own work." (Software Team Leader)

All of the respondents believed that good communications and collaboration with network members is vital in this regard. However, this is not something that is easy to achieve. As was pointed out "collaboration is not easy, it is not going to come by itself. So you need a mindset of collaboration. That's very important. Additionally, if you co-operate with many participants in the company, things can and often do go wrong. To recover from that very fast, you need to have quite a stable base. Otherwise you are in an endless tragedy" (Software Team Leader).

Table 3: Challenges Associated with Inner Source Networks

Challenges	Explanation
Achieving a high level of commitment	Commitment by all stakeholders is crucial but difficult to achieve. Product team leaders are often only concerned with having work on their project done correctly and are not overly concerned about the platform. People would be more committed and motivated if incentives were offered.
Increasing knowledge sharing and exchange	Difficult to get people to invest time or effort in sharing and building skills and knowledge outside their own domain.
Achieving a common vision	Important to have a clear unifying vision so people don't waiver off in different directions and send out mixed messages to the rest of the teams
Effective governance of the network	Managers are used to controlling and regulating things in a closed environment and do not offer incentives that encourage commitment, transparency and knowledge exchange in an informal capacity in the network.

Thus, it was found that it is important to have a clear vision, a common goal and a successful alignment of objectives. Otherwise, platform teams can waiver off in different directions, which can send out unclear messages to the other teams. To overcome this, constant and repeated communications is vital. Additionally, it was found that frequent exchange through continuous interaction, shared values, commitment and trust are crucial in successfully maintaining these internal networks. In addition, if more incentives were offered by the company to keep people motivated in contributing to the platform, the model could be a lot more effective. However, it was found in the study that while senior managers see the necessity of the inner source initiative, often they are in their

job position because they are good at controlling things and setting up structures to govern and regulate things and ensure they have results. As was pointed out "that type of personality is not necessarily the best in an open innovation kind of model" (Software Team Leader). Co-development activities and projects often involve informal discussions but much broader issues are decided in formal settings such as contractual agreements, steering committees and architecture boards that govern how the process works. As one interviewee explained " we do have agreements with our stakeholders that okay, we are going to do this for you and you are going to do this for us…and so we make agreements on how we exchange for example results or people… and this is something that's absolutely necessary" (Software Team Leader). Formal architect meetings and platform group meetings in which all interested parties can participate take place on a regular basis.

5 Discussion and Conclusion

Gassmann and Enkel's framework proved to be an effective lens with which to examine inner source as a form of open innovation within the organisation. All three open innovation archetypes can be tailored to investigate this phenomenon and we have modified the framework to demonstrate this (see Figure 2). Our case study findings reveal that all three open innovation processes are in operation in the organisation. Additionally, it was found that the company has reaped many benefits from its use of inner source principles. For example, as part of an outside-in process, the central team in the company have adopted an open, collaborative mode of development by involving and utilising the expertise and knowledge of all internal customers, i.e. other business units. Additionally, developed software, training, support and information are made readily available to all business units as part of the central team's inside-out approach. The coupled process is also evident in that product and platform teams work together as part of a global network in co-development activities and projects. Applying these open innovation archetypes has enabled successful new product launches for the company as a whole.
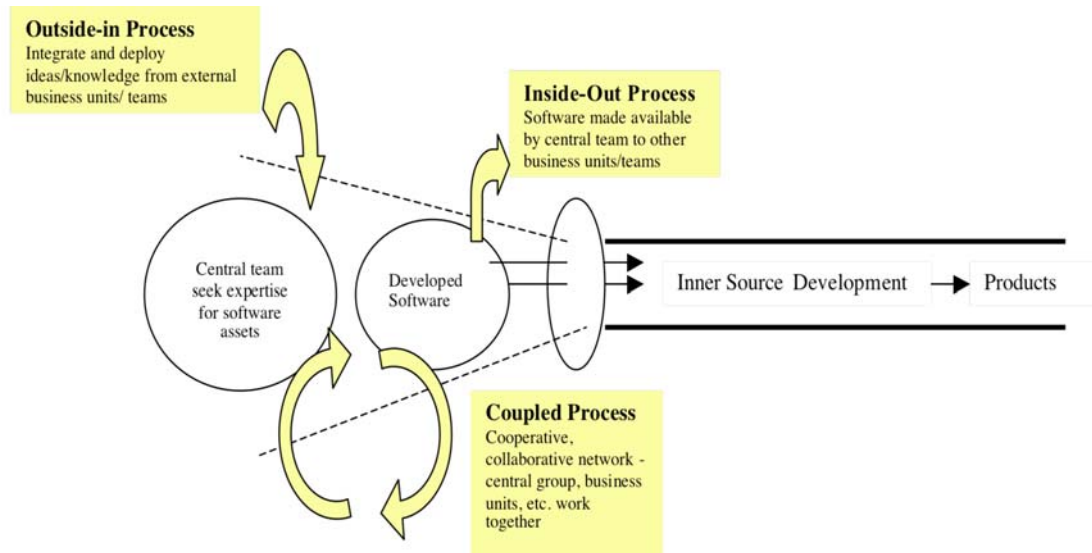

Figure 2: Applying Open Innovation Principles within the Organisation

However, there are some challenges to successfully establishing and maintaining cooperative and collaborative relations with stakeholders outside the central team or business unit. Such challenges comprise achieving a high level of commitment, knowledge sharing and exchange, a common vision and an effective governance process, issues which should be addressed in more detail in future research. While these challenges are not new and have emerged in literature in recent years on inter-organisational networks, these issues have not been explored at the intra-organisational open innovation level. Additionally, in previous literature on open source communities and networks, the

challenges of such networks were observed in the absence of hierarchical governance arrangements. As is evident from the case study, with inner source development, hierarchical governance exists inside the company. Thus, while inner source can be seen as a good example of intra-organisational open innovation, the concept deviates from the more philosophical, bazaar-like nature of open source development - one that is based on peer production without any reliance on managerial hierarchies, contracts or governance models. The study also revealed that introducing inner source principles within the organisation requires significantly changing internal processes and structures. Future research could consider other organisational variables such as cultural aspects when examining open innovation at the intra-organisational level. Moreover, issues such as the rewards and incentives needed to motivate people to network and collaborate in an open manner could also be addressed by researchers. Indeed, issues such as these should be investigated as they are likely to affect how managers deal with risk and control issues associated with governing internal open innovation in addition to the external relationships required for leveraging open innovation within the organisation. This study utilised a single case study. Future research should consider multiple case studies that go deeper into the level of analysis on each of the three open innovation processes within the organisation. However, as the aspect of open innovation within an organisation has largely been ignored to date, we contribute to the existing literature on open source software and open innovation, in particular to the area of inner source and intra-organisational networking.

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